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THE HISTORICAL POINT OF VIEW IN THE TEACHING OF SCIENCE[1]

THE teachers of Missouri should take special interest in the history of science at the present time in view of the fact that the American Association for the Advancement of Science is expected to meet soon in this state and the question of forming a special section of this association for the purpose of considering topics in the history of science is to be raised during this meeting. Teachers of mathematics have an additional reason for taking an unusually keen interest in this subject just now in view of the appearance during the past summer of two very important books on the history of their subject.

One of these is entitled "History of the Theory of Numbers" and was prepared by Professor L. E. Dickson, of the University of Chicago, while the other bears the more general title "A History of Mathematics" and was prepared by Professor Florian Cajori, of the University of California, who holds the unique position of a regular professorship of the history of mathematics in a university. The former book is the first volume of the most complete history of number theory ever written and marks an epoch in American mathematical literature, while the latter is technically only a "revised and enlarged edition" of a book which appeared a quarter of a century ago under the same title, but the changes are so extensive that it too may be regarded as practically a new work.

The history of science should also be of peculiar interest to all educated people at the present time in view of the fact that this history is now being made very rapidly. The important rôle played by science in the recent world war can never be forgotten, especially since it points to a largely increased impor-

[1] Read before the Missouri State Teachers Association, November 7, 1919.

tance of science in a future great war in case there will be another. Perhaps the immediate development of applied sciences will be retarded by the feeling of security which a League of Nations may foster but pure science, which constitutes the foundation of applied science, is in need of calmer times for its most vigorous and systematic development. While war exhibits forcibly the need of science, times of peace create the atmosphere for scientific growth from the bottom, and the great rôle which science played in the recent war was doubtless largely due to the long period of comparative peace which preceded it.

One of the most striking events in the history of science has been the recent termination of former international scientific organizations and the steps towards the formation of new ones with a greatly increased amount of machinery. The whirl of organization machinery like the thunder of the cannon may serve to exhibit needs of science but it can scarcely be expected to create an atmosphere suited for the best scientific growth. If the scientific organizations are to become as complex as our American university organizations, so that those who secure the most prominent positions are administrative experts instead of eminent representatives of scholarship and research, there is good ground for misgivings at the present time.

A possible portent of great significance not only in the history of science but also in the history of education in general is the disturbed money condition which enables one to secure at present foreign books at an unusually low price. I recently paid a bill for some French books which were contained in a parcel post shipment made by a German firm shortly before we entered the war and were siezed in transit by the British government. I had to pay less than one fifth of the pre-war price for these books as a result of the small present relative value of the German mark.

If somewhat similar conditions prevail for a considerable time it seems likely that America will secure an unusually large amount of the literature now stored in Germany. As a result thereof our scholars may soon enjoy the best library facilities in the world and with this should come greater initiative especially along historical lines. Europeans have often made fun of our magnificent library buildings containing a comparatively small number of books. It is to be hoped that this number will soon be greatly increased as books are the most inexpensive educational agencies even in normal times and many of the older good books are likely to be sold at abnormally low prices for some time.

Notwithstanding these present special interests in the history of science, teachers should have a deeper interest in the permanent features of this history. Prominent among these features is the element of imperfection. Who is not interested when he first learns that Paciuolo the author of a very influential Italian work printed towards the end of the fifteenth century, tried to harmonize the facts that in Genesis the term "multiply" is used in the sense of increasing while if we multiply a proper fraction by a proper fraction we get a smaller product than either factor? Paciuolo concluded that increasing meant getting further away from unity; *e. g.*, $\frac{1}{2} \cdot \frac{1}{3} = \frac{1}{6}$, and $\frac{1}{6}$ is further from unity than either $\frac{1}{2}$ or $\frac{1}{3}$. In this way he thought he had explained the term multiply as regards proper fractions so as to be in accord with its use in the Bible.

Not an insignificant element of the educational value of the history of science is the opportunity which this history affords to inspire the student by the knowledge of having a clearer understanding of some scientific facts that the intellectual giants of earlier times had. If he is inclined to regard the rigorous geometrical demonstration of Euclid as superhuman he may be led to view the matter in a truer light by noting that Euclid was ignorant of the use of zero as a number as well as of the advantages of negative numbers. If he is dazzled by the deep mathematical insight of Newton he may realize his own mathematical advantages better when he learns that Newton knew nothing of the

brevity and elegance resulting from the use of determinants.

Fortunately the desire to excel is common to the young and old. I have often wondered to what extent the deep interest which women exhibit towards children, especially towards babies, is enhanced by the fact that in them they find human beings who do not pretend to know as much or more than they themselves do. At any rate the interest of young students can often be most easily aroused by guiding them so that they can experience that in at least some particulars they can make improvements on the work of others. The occasional discussion of possible improvements on the text-book or on articles in standard works of reference may serve a useful purpose if it is conducted in the right spirit. That some of the best works afford opportunities for such discussions may be illustrated by the article on "mathematical signs and symbols" in the new edition of the Encyclopedia Americana which is now almost completed and is noteworthy on account of its valuable mathematical articles.

The history of science is also useful because it instils optimism. That the history of science is in the main a history of progress needs scarcely to be emphasized in these days of rapid economic charges due to new scientific discoveries. The progress of science is in part reflected in the many new inventions and improvements contributing to our comfort in sickness and in health. The fact that these inventions and improvements are finally based on the work of such a large number of scientific investigators directs attention to the vast opportunities of rendering useful service in the field of science, and one of the most striking elements of the history of science is the fact that our rich scientific heritage is due to the work of millions for world betterment.

In the study of the history of science as well as in the study of science itself many students meet with the dilemma that what they would most like to know they can not know and what they can know they care little about. In both cases real progress is usually coupled with a willingness to work where progress seems possible. One of the most striking instances of this fact is furnished by the history of our common numerals. For centuries mathematical historians have been interested in the origin of these numerals and for a long time there was almost complete agreement that they were of Hindu origin and were transmitted to Europe by the Arabians. Hence the common name Hindo-Arabic numerals.

During the last dozen years various mathematical historians have re-investigated this question and have reached the conclusion that these numerals originated in Europe and not in Asia. One of the most active supporters of this new theory is G. R. Kaye, an Englishman residing in India, who wrote a book on "Indian Mathematics" (1915), and is inclined to give little credit to the Hindus for originality in mathematics. Instead of calling our common numerals "Hindu-Arabic" or "Babylonic-Hindu" it would be more in accord with our present state of knowledge to admit that they are of unknown origin, and if a student of the history of mathematics insists on knowing the origin of zero before taking up other historical questions it is likely that his knowledge of this history will remain zero.

As Cajori's history, to which we referred above, will probably be used widely as a text-book it seems desirable to refer here to a peculiarity which might otherwise cause perplexity. The author of this history speaks at various places about the origin of our common numerals and at all of these places save one he supports the theory that they are of Hindu origin. This single exception appears in a note on page 98 where he acknowledges our ignorance in regard to the origin of these numerals without, however, acknowledging explicitly his recent conversion to this view. It therefore happens that both those who support the theory of the Hindu origin of our common numerals and those who acknowledge agnosticism as regards their origin can find support of their views in different parts of the same book.

This singular fact seems to deserve public notice also because Cajori's work is the

largest and most modern general history of mathematics in our language and all English-speaking people who seek reliable information in regard to the development of this subject will naturally turn to it. The general reader will find here not only a history of the older mathematical developments but also a large amount of information about modern developments with due references to the contributions made by Americans.

Until recently America's share in the history of the advancement of mathematics was practically confined to the last fifty years, but recent study of the hieroglyphic writings of the Maya Indians of Central America and southern Mexico has established the fact that America has also a place in the history of ancient mathematics. In fact, the Maya used a kind of zero very early, possibly as early as the beginning of the Christian era. Their contributions are, however, very insignificant in comparison with those of the ancient Greeks, so that America has had only a small share in the advancement of mathematics except during the last half century.

Perhaps the most important feature of the history of science for teachers is the fact that in a broad way the history of the world portrays the history of the individual. Concepts which the world learned slowly are usually grasped slowly by the individual and the difficulties which the world experienced in the assimilation of these concepts are reflected in the individual student. Since the history of mathematics is so very old it is especially rich in suggestions as regards the learning process.

Another important feature of this history is that it tends to a clearer grasp of the most fundamental and fruitful facts of science. For instance, a great part of the development of mathematics during the nineteenth century centers in the ordinary complex numbers and in Taylor's expansion. It is interesting to note that for over fifty years from the time of the discovery of this expansion (1712) its importance was not generally recognized, and this fact furnishes another illustration of the difficulty involved in estimating the value of contemporary work in pure mathematics.

The history of science is interesting on account of its inexhaustible riches. Substantial progress in this field depends on the use of the intellectual telescope. Nothwithstanding the great importance of the use of the intellectual microscope which characterizes and ought to characterize most of our scientific work there is a charm for the student at times in using also an intellectual telescope in his scientific outlook. Like the distant sun warms and fructifies our earth so distant scientific facts stream into our present life and constitute the source of our present scientific activity. Just as we are interested in the sources of the rays of physical light that cheer us by day and by night so we should be interested in the sources of the rays of intellectual light shining through the scientific literature and illuminating our intellectual pathway.

Few may be interested in a proof of the fact that the point of inflexion of every curve whose equation is of the form

$$y = x^3 + ax^2 + bx + c$$

is a point of symmetry and hence the graph of a quadratic in one unknown has always line symmetry while that of a cubic has always point symmetry, but every one is likely to take an interest in the discussions of the ancient Greeks relating to whether a straight line can be equal to a curved one, as well as in the contention that Achilles could not overtake the tortoise since he must first reach the place from which the tortoise started, but by the time he reaches this place the tortoise has moved ahead. Such scientific ideas from the springtime of intellectual world life have a perennial interest, especially for those in the springtime of their own intellectual life.

The history of science best suited for the young student is that which relates to fundamental questions which are apt to perplex him and not that relating to the preservation of the obsolete from oblivion. The historic setting should constitute the sugar coating of the otherwise bitter scientific pills. The body of the pill should, however, be selected for its curative properties. It must be remembered

that many of us are intellectually sick because we have not properly assimilated fundamental truths and the function of the teacher is to cure such intellectual disease after a proper diagnosis as well as to provide wholesome food for the healthy mind. My advice to the Missouri teachers therefore is: Provide yourself with a considerable variety of pills sugar-coated with scientific history and use them somewhat sparingly like other medicine, but be prepared to use them both as a preventative and as a cure whenever the occasion presents itself.

G. A. MILLER

UNIVERSITY OF ILLINOIS

THE SINGING SANDS OF LAKE MICHIGAN

THE dune region of Lake Michigan extends along its eastern shore from Gary at the southern extremity to Mackinac at the northern with comparatively few breaks or interruptions. Throughout this region the sands near the water's edge, in dry weather, emit a peculiar but definite and unmistakable sound when the foot of the pedestrain pushes through them in an abrasive way. This unusual sound from an unusual origin is a source of great delight to children and an inciter of the curiosity of their elders, who, however, rarely pursue the subject far enough to arrive at an explanation for it. The sound is produced not only by the leather-shod foot, but is emitted also if the bare foot or hand is struck through the grains or if a stick is trailed, boy-fashion, behind.[1]

[1] (See Thoreau's "Journal," entry of September 22, 1858, in "Autumn.") "One mile southeast of the village of Manchester struck the beach of 'musical sand,' . . . . We found the same kind of sand on a similar but shorter beach on the east side of Eagle Head. We first perceived the sound when we scratched with an umbrella or the finger swiftly and forcibly through the sand; also still louder when we struck forcibly with our heels, 'scuffling' along. The wet or damp sand yielded no peculiar sound, nor did that which lay loose and deep next the bank, but only the more compact and dry. The sound was not at all musical, nor was it loud. . . . R———, *who had not heard it,* was about right when he said it was like that made by rubbing wet glass with your finger. I thought it as much like the sound made in waxing a table as anything. It was a squeaking sound, as of one particle rubbing on another. I should say it was merely the result of the friction of peculiarly formed and constituted particles. The surf was high and made a great noise, yet I could hear the sound made by my companion's heels two or three rods distant, and if it had been still, probably could have heard it five or six rods."

The sound has been compared or the attempt has been made to relate it to that produced by the pedestrian walking through soft snow; to the crunching noise so frequently noticed when walking through snow after very cold weather or by the wheel of a vehicle on such snow; also to the sound emitted by hard, granular snow when one walks through it; but it is like none of these and has a distinctive character all its own.

In a preliminary way several observations should be recorded as to the bearing of location and conditions of various sorts on the singing sands. The sound is produced only when the sand is dry, and apparently the dryer the sand is, the louder the sound produced. In wet weather or when the sand is moderately moist, the sound is not produced. In summer and indeed in the hottest weather the sound seems to be loudest, other conditions being the same, but it can be clearly heard at all seasons of the year, including winter, whenever the sand is dry. As one walks away from the water's edge he may be astonished to find out that the sound-producing sand ceases rather abruptly about fifty to one hundred feet from the shore line. These limits may vary at different locations but on the whole they are substantially correct. Back and away from the shore line, in blowouts and on the sides and tops of the dunes, the sound is never produced. There is no observable difference between the sand located near the shore and that located farther back or that forming the dunes, and indeed the sand which is washed up by the waves is that which, blown by the wind, goes to form the dunes.

The upper beach limit of the singing sands

is practically identical with the upper wave limit, that is, the boundary reached by the waves during storms. This limit is marked roughly by the line of driftwood and the lower limit of vegetation. The singing sands are therefore all subjected to periodical contact with the water of the lake and are moistened and washed by that water.

These observations include, I think, all the obvious ones in connection with the singing sands. The most casual observer will remark with astonishment their very sharply defined upper limit. As one walks from the water's edge up the beach and crosses the upper wave limit, he notices a sudden cessation of sound as he passes the upper line of driftwood and the commencement of vegetation. Beyond this point he may proceed into a blowout of clear sand quite identical in appearance, macroscopic as well as microscopic, and of the same composition by ordinary methods of analysis and yet this sand fails entirely to produce the sound of the beach sand. His first conclusion would be that the proximity of the water and waves of the lake must have some relationship to the sound-producing grains.

I wish to apologize in advance for offering an hypothesis of this sound production unsupported by convincing evidence. What follows may, however, serve as a working basis for other investigators and may lead to a true explanation of the sound-production.

My hypothesis briefly stated is this. The sand grains on the lower beach and as far as the upper limit of the storm beach are bathed periodically by the waters of the lake which contain various salts including calcium and magnesium bicarbonates. This water dries on the grains of sand, coating the surfaces with an extremely thin film of salts including calcium and magnesium carbonates. This film is of such a nature as to create considerable friction when rubbed and thus when the grains are brought into contact with various surfaces a sound is emitted. One may compare the action of the film of dried salts on the sand grains with the action of rosin on the violin bow. The beach sand is, of course, the same sand which later goes to form the dunes when transported by the wind but during this transportation, due to the abrasive action of grain against grain, much of the salt film is rubbed off and carried on by the wind in the same manner that clay dust is, to be deposited in quiet places as on the forest floor beyond. After deposition in blowouts or on dunes, the grains are subjected from time to time to the leaching action of rain water and this completes the removal of calcium and magnesium carbonates (in the form of bicarbonates and of the other salts) so that the original sand grain surface is restored or, to speak metaphorically, the sands lose their singing voice. Such is the hypothesis.

A typical analysis of Lake Michigan water shows the following constituents:[2]

	Parts per 1,000,000
Total residue	144.8
Loss on ignition	17.6
Chlorine	4.2
Sodium Na	8.3
Ammonium (NH_4)	.05
Magnesium Mg	10.9
Calcium Ca	28.2
Silica Si	1.9
Nitrate NO_3	1.0
Chloride Cl	4.2
Sulphate SO_4	10.0

Some samples of Lake Michigan water show a higher content of solids than that given in the above analysis, the maximum being about 160 parts per million.

When the singing sand from the beach is compared with dune sand or blowout sand under the microscope no difference is perceptible. When subjected to screen tests, the beach sands show themselves to be of the same physical composition and texture. By chemical analysis, according to the usual methods of conducting mineral analyses, both show the same composition. The amount, therefore, of salts in the hypothetical film above referred to must be therefore within the limits of analytical error.

Experiments to prove or disprove the hypothesis readily suggest themselves. Some of

[2] Bull. No. 10, Illinois State Geological Survey, 1909, "The Mineral Content of Illinois Waters."

the singing sands could be transported from the beach and placed in a perforated vessel, box or barrel, on dune or in blowout and left to be subjected to the action of rain for a considerable period of time, or some of the singing sands could be subjected to a tumbling action by rotating as in a laboratory rotating tumbler. After this some sand could be subjected to the leaching action of distilled water saturated with CO_2. For a third experiment, some of the dune or blowout sand could be wetted several times with lake water and subjected to a drying action between the wettings. Suitable sound tests should, of course, be made at the proper times.

These experiments should be performed by some one residing by the lake shore either permanently or during the summer so that advantage could be taken of changing weather conditions and rainstorms.

W. D. RICHARDSON

SCIENTIFIC EVENTS

THE HOUSE OF JOSEPH PRIESTLEY

THE original house and laboratory of Dr. Joseph Priestley, the great chemist who discovered oxygen in 1774, and came twenty years later to America, which is located on the banks of the Susquehanna river, at Northumberland, Pa., was purchased recently by graduate students of the Pennsylvania State College, who plan to move it to the campus and make it a lasting memorial.

Upon learning that the Priestley homestead, which was built in 1794–1796, was to be put up at public auction, the Penn State chemists sent as their representative to the sale Dr. G. G. Pond, dean of the School of Natural Science at the college. He was successful in making the purchase, and the historic mansion will be preserved.

Architects from the college will at once make the necessary surveys preparatory to the work of moving the Priestley house to the campus at State College. The house is of frame, and painting has kept the woodwork in a remarkable state of preservation, so that it may be possible to rebuild the greater part of the structure from the present lumber. Immense pine timbers used in the framework are as good as new and the old-fashioned interior decorations—arched doorways, fireplaces and stairway—are in such condition that they can be removed and replaced with comparative ease.

While the purchase of the house has been made by Dr. Pond for the Penn State chemistry alumni, who are scattered to all parts of the country, funds for its removal and erection on the college campus will be supplied by an as yet unnamed donor. Actual work of removal will probably be started in the spring. Northumberland is about sixty miles from State College, at the intersection of the north and west branches of the Susquehanna.

The reconstruction on the college campus will be along the old architectural lines, but modernized and adapted to some suitable use by the school of Natural Science, according to present plans. The house is an old landmark in Northumberland county, and can be seen on the outskirts of the town from trains on the Pennsylvania Railroad passing Northumberland. It is a two-story structure, with capacious attic space. It is about 45×50 feet, with a projection at each end about 25 feet square. One of these was the kitchen and the other the workshop, or laboratory, in which Priestley pursued his scientific study and experiments.

CIVIL SERVICE EXAMINATIONS

THE United States Civil Service Commission announces the following examination:

On December 23 for meteorologist (men only). Vacancies in the Signal Service at large of the War Department throughout the United States, at salaries from $1,600 to $3,000, and in positions requiring similar qualifications, will be filled from this examination. The entrance salary will depend upon the qualifications of the appointee. The duties of appointees will consist of the making, computing and recording of meteorological observations in connection with the meteorological service of the U. S. Army; also the instruction of enlisted men in such work. Competitors will not be required to report for examination at any place, but will be rated on

the following subjects, which will have the relative weights indicated, on a scale of 100: (1) Education, 40; (2) Experience, 60. Competitors will be rated upon the sworn statements in their applications and upon corroborated evidence.

On December 10 for assistant observer, Weather Bureau, for unmarried men. Vacancies in offices of the Weather Bureau throughout the United States, and in positions requiring similar qualifications at $1,080 a year, or higher or lower salaries, will be filled from this examination.

Applications will be received until further notice for associate physicist qualified in physical metallurgy, for men only, at salaries ranging from $2,000 to $2,800 a year; and assistant physicist qualified in physical metallurgy, for both men and women, at salaries ranging from $1,400 to $1,800 a year, to fill vacancies in the Bureau of Standards, Department of Commerce, for duty in Washington, D. C., or elsewhere, and in positions requiring similar qualifications in other branches of the service.

For scientific assistant, for both men and women, on January 7 and 8. Vacancies in the Department of Agriculture, for duty in Washington, D. C., or in the field. The usual entrance salary for this position ranges from $1,320 to $1,620 a year, but persons showing in their examinations that they are unusually qualified are occasionally appointed at higher salaries, not to exceed $1,860 a year.

SALARIES AT YALE UNIVERSITY

The Yale Corporation at its last meeting increased the normal salary scale for full professors doing full-time work of a satisfactory character (which has in the past been $4,000, $4,500 and $5,000) to $5,000, $6,000 and $7,000, with the understanding that $8,000 will be given in a very few cases to men of exceptional ability as teachers and productive scholars. It is believed that this action, which will be retroactive from July 1, 1919, places the average salary scale for professors at Yale University above that of any other university in America, although in two or three other institutions a very small group of men receive as much as $10,000. Some full professors with whom special arrangements have been made will continue at lower salaries, but a majority will receive at least $5,000 or $6,000 a year. The vote passed by the corporation is as follows:

Voted, to approve the recommendation of the Salaries Committee that the following should be the normal salary standard, to be departed from only in exceptional cases:

Professors, full time	$5,000–$8,000
Professors, part time	$3,000–$6,000
Assistant and associate professors	$2,500–$4,500

The salaries of the deans of the different schools were placed at from $6,000 to $8,000, depending upon the amount of work and responsibility devolving upon each.

The corporation adopted the following as the main criteria for determining salary increases within the normal scale:

(*a*) Usefulness as a teacher.

(*b*) Productivity and standing in the world of science, letters or art.

(*c*) Public service, including service to the university.

(*d*) Executive responsibility and efficiency.

These criteria were decided upon and the individual salaries are being determined as a result of the following vote passed by the corporation at its previous meeting:

Voted, to authorize the president and the chairman of the committee on educational policy in consultation with the deans of the college, and scientific school, and the graduate school to prepare a list of salary increases to be voted on at the next meeting, together with the criteria to be adopted in assignments to salary grades, with the understanding that the deans of other schools will be consulted when the salaries of their professors are under consideration.

Full-time instructors and assistant professors in the undergraduate schools doing satisfactory work had their salaries raised last spring—the former from the old $1,000–$1,600 to the new $1,250–$2,000 scale; the latter from $2,000, $2,500 and $3,000 to a new scale $500 higher for each grade. Some further increases of assistant professors' salaries are now under consideration by the joint committee of the

corporation and deans named above. It is expected that all decisions will be reached and all full professors in the university, aside from members of the law and medical school faculties, whose salaries were decided upon last year, will be informed on December first with reference to their salary status, a special meeting having been called for November 29 when the salary list will be finally acted upon.

CRYSTALLOGRAPHICAL AND MINERALOGICAL SOCIETY OF AMERICA

FOR several years the formation of a Crystallographical and Mineralogical Society of America has been contemplated, but the final steps leading to organization were postponed until after the close of the war. Those most concerned in the undertaking have recently been canvassed, and it is now expected that the society will be definitely organized during the meetings of the Geological Society of America in Boston, December 29 and 31.

The purpose of the society is to promote interest in crystallography and mineralogy and allied sciences. Although crystallographers and mineralogists in European countries have long been organized, there has never been a national organization in America. At some of our larger universities mineralogy was one of the first sciences to be taught. Further, the growing application of mineralogy in the development of our vast mineral resources and the increasing use of mineralogical methods in allied sciences and in industry demand an ever-increasing number of technically trained men. There are therefore sufficient reasons why those actively engaged in these fields of science in America should be banded together.

In the organization of the society it is proposed to have two types of membership, such as fellows and members, or members and associate members. The first group would include persons who have published results of crystallographical and mineralogical research, while the second group would consist of persons engaged or interested in crystallographical and mineralogical work. It is planned to hold annual meetings for the reading of papers and the transaction of business, as is customary with national scientific societies. It is also hoped that the society will soon be able to support an independent publication, preferably a monthly journal, devoted entirely to the special field of the society. American crystallographers and mineralogists have long realized the need of such a journal in which their contributions could be published without necessary delays.

Annual fees of $3.00 to $5.00 are suggested. These annual fees are to include subscription to the journal of the society when established, which preliminary investigations indicate can be done in the near future.

All interested in the founding of this society are urged to attend the organization meeting to be held in Boston, at the Copley Square Hotel, Tuesday, December 30. Further, all prospective members regardless of whether or not they can attend the above meeting are requested to communicate with Edward H. Kraus, University of Michigan, Ann Arbor, Mich.

EDWARD H. KRAUS
(Michigan),
ALEXANDER N. PHILLIPS
(Princeton),
FRANK R. VAN HORN
(Case),
THOMAS L. WALKER
(Toronto),
EDGAR T. WHERRY
(U. S. Bureau of Chemistry),
HERBERT P. WHITLOCK
(American Museum of Natural History)

THE AMERICAN SOCIETY OF ZOOLOGISTS

THE American Society of Zoologists will hold their annual meeting in St. Louis, December 29 to 31. The sessions on Monday, Tuesday and on Wednesday morning will be open for the presentation and discussion of papers. In agreement with the Botanical Society of America, the genetics papers will be placed on Tuesday morning. Tuesday afternoon will be given over to a joint session with the American Ecological Society in which half of the program will be given by each so-

ciety. An invitational program has been arranged for Wednesday afternoon as follows:

C. E. McClung: "The work of the National Research Council in relation to zoology."

J. T. Patterson: "Studies in Polyembryony."

C. H. Eigenmann: "Faunal areas on the Pacific slope of South America."

V. E. Shelford: "Physiological life histories of terrestrial animals."

The entire program is in conjunction with Section F of the American Association for the Advancement of Science. The address of Professor William Patten, of Dartmouth College, the retiring vice-president of Section F, will be given following a zoology dinner on Wednesday evening, December 31. The subject is: "The Message of the Biologist." Following the address, moving pictures taken on his recent Barbadoes-Antigua Expedition will be shown and explained by C. C. Nutting.

The Statler Hotel will be headquarters for the zoologists.

W. C. Allee,
Secretary-Treasurer

THE SECTION OF GEOLOGY OF THE AMERICAN ASSOCIATION

Section E—Geology and Geography—of the American Association for the Advancement of Science will hold its meetings at St. Louis, Mo., on Tuesday and Wednesday, December 30 and 31, with the possibility of an extra session on New Year's Day if enough papers are offered to make such a session desirable. The address of the retiring vice-president of Section E, Dr. David White, of the U. S. Geological Survey, will be upon the topic "Geology as it is taught in the United States." One joint session with the Association of American Geographers is being planned. The meetings of Section E will be presided over by Dr. Charles Kenneth Leith, of the University of Wisconsin. Titles of papers to be read before the Section should be in the hands of the secretary, Dr. Rollin T. Chamberlin, University of Chicago, before December 12.

THE SECRETARYSHIP OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

At a meeting of the committee on policy of the American Association for the Advancement of Science, held in New York City on November 13, Dr. L. O. Howard, who has served the association for twenty-two years as permanent secretary, stated that in view of the great enlargement in the work of the Bureau of Entomology, of which he is the chief, and the increasing responsibilities of the office of the permanent secretary of the association, he felt unable to hold much longer the two offices. He proposed that efforts be made to find an executive officer who would devote his entire time to the work of the association and the national organization of scientific work and scientific men for the promotion and the diffusion of science. There was consequently appointed a committee on the permanent secretaryship, consisting of Dr. Simon Flexner, president of the association, Professor A. A. Noyes, and Dr. J. McKeen Cattell.

It is believed that the secretaryship of the Smithsonian Institution, the presidency of the Carnegie Institution of Washington, the chairmanship of the National Research Council and the permanent secretaryship of the American Association for the Advancement of Science, are offices of coordinate importance, and that the secretary of the association, directly responsible to the scientific men of the country, should hold a position and exert an influence not inferior to that of any scientific man in the United States.

The filling of these offices is difficult, for it is undesirable to divert able scientific men from their work. But in the existing state of society there are needed those who will sacrifice their research work in order that others may have better opportunity, as in war men are ready to sacrifice their lives to enable others to live in freedom. It is possible that the secretary of the American Association by proper organization of scientific societies, scientific institutions and scientific men and by securing the interest and support of the public might increase by ten per cent. the productivity of science in America; only a Newton or a Darwin could do so much by his individual research.

The conduct of research under modern conditions requires executive ability, and men of

science are likely to possess this quality, as has been demonstrated by those who have been called upon for administrative work both in peace and in war. In filling executive positions of a scientific character, however, it may be desirable to consider those whose scientific work can be replaced, and those not engaged in research, but having a sympathetic interest in its promotion.

For the secretaryship of the American Association a man is needed who, either through his own work or through association with men of science, appreciates the supreme importance of scientific research for human welfare, both when its applications are obvious and when they are not. He must know that research can only be advanced by drawing to it the ablest men and by giving them the best opportunities, and that for recruits and for support the sympathetic interest of a wide public is essential. He should have the executive and administrative ability which keeps details in order and initiates new movements, and at the same time possess those personal qualities that compel others to share his convictions.

The committee on the permanent secretaryship of the American Association will be glad to receive suggestions concerning the conduct of this office and concerning men competent to fill it. The committee on policy has recommended an increase of the annual dues to $5, and with its 12,000 members the association should be able to support the secretary and his work as adequately as the office warrants.

SCIENTIFIC NOTES AND NEWS

DR. FRANK SCHLESINGER, director of the Allegheny Observatory of the University of Pittsburgh, has been elected director of the Yale Observatory.

MR. C. H. BIRDSEYE has been appointed chief topographic engineer of the U. S. Geological Survey, to succeed M. R. B. Marshall, who recently resigned as chief geographer. Mr. Birdseye was formerly chief of one of the divisions of topographic mapping and during the war served in France as lieutenant-colonel of the Coast Artillery.

COLONEL FREDERICK F. RUSSELL, of the Medical Corps of the army, has been appointed official representative of the medical department of the army in the government division of the National Research Council.

DR. FRANKLIN H. MARTIN, of Chicago, formerly colonel, M. C., U. S. Army, had conferred on him the Order of Commander of Saint Michael and Saint George by the Prince of Wales, in Washington, D. C., on November 14.

THE Boylston Medical Committee appointed by the president and fellows of Harvard College and consisting of Dr. William F. Whitney, chairman, Dr. Harold C. Ernst, Harvard Medical School, Boston, secretary, and Drs. William T. Porter, Edward H. Nichols, Reid Hunt, Henry A. Christian and John Warren, announces that at the annual meeting, held in Boston, in 1916, a prize of $300 was awarded for an essay entitled "Studies of the Streptococus of Smith," by Dr. Wilson G. Smillie, Cambridge, Mass.

R. C. ALLEN, Michigan state geologist, has resigned his office to become secretary of the Lake Superior Iron Ore Association, with offices at Cleveland.

MR. D. DALE CONDIT has resigned from the Geological Survey, and Mr. Ralph W. Howell is on a year's leave of absence, to accept positions as petroleum geologists with S. Pearson and Sons, Ltd. They sailed for England about the middle of October. Professor Olaf P. Jenkins, of the University of Arizona, who, as we recently announced, had planned to accept a position with this company has become geologist with the Sinclair Consolidated Oil Corporation, in New York City, and Mr. A. C. Veatch has been placed in charge of the exploration department of the same company.

THE council of the Ray Society has appointed Dr. W. T. Calman, of the Zoological Department, British Museum (Natural History), to be secretary in succession to the late Mr. John Hopkinson.

DR. WILLIAM H. RANKIN, for the last five years assistant professor of plant pathology in

the college of agriculture, Cornell University, has been appointed officer in charge of the Field Laboratory of Plant Pathology of the Canadian Department of Agriculture, with headquarters at St. Catherine's, Ontario, and has entered upon his work.

E. J. Lambert and A. J. Carlson, professors of the University of Minnesota, have completed an examination of the Mesabi and Vermilion range in the interest of the Minnesota Tax Commission.

Wilson Popenoe, agricultural explorer in the Bureau of Plant Industry, U. S. Department of Agriculture, sailed from California on November 12 for Central and South America, where he will search for economic plants worthy of introduction into the warmer portions of the United States. It is particularly planned to investigate the wild and cultivated avocados, and to obtain the most promising ones for trial in this country.

Mr. Robert Cushman Murphy, of the Brooklyn Museum, is in Peru, where he is engaged in making investigations of the birds of the coastal islands. Moving pictures will be made of some of the colonies of pelicans, cormorants, and other sea birds of that region.

Dr. Henry Krepelka, of Prague, in Czecho-Slovakia, has been appointed to a research fellowship in chemistry at Harvard and is engaged in the study and investigation of atomic weights under the guidance of Professor Theodore Richards. Dr. Krepelka has been serving as assistant to Professor Brauner, who is director of the chemical laboratory of the University of Prague.

At the 823d meeting of the Philosophical Society of Washington on November 8, R. W. G. Wyckoff presented a paper on "The nature of the forces between atoms in solids" (illustrated), and H. L. Curtis, R. C. Duncan and H. H. Morse on "Methods of measuring ballistic phenomena on a battleship."

Dr. E. V. McCollum, professor of chemical hygiene in the school of hygiene and public health of the Johns Hopkins University, delivered an address before the Franklin Institute of Philadelphia on November 13, on "Nutrition and physical efficiency." On November 25 he spoke before the Institute of Medicine of Chicago on "The fundamental principles underlying modern nutrition investigations."

The Bradshaw Lecture before the Royal College of Physicians was given on November 6, by Dr. A. P. Beddard, who spoke on chronic arthritis. The Fitzpatrick Lectures were given by Dr. Edgar G. Browne on November 11 and 13, the subject being "the origin and development of Arabian medicine."

UNIVERSITY AND EDUCATIONAL NEWS

Owing to the death of Mr. Edward M. Reed, which occurred on October 26, 1919, there is released for the general purposes of Yale Observatory one third of the estate of Edward M. Reed, the amount which should thus be added to Observatory funds during the year being estimated at $60,000 or more.

By the will of Lawrence E. Sexton, a New York lawyer, Harvard University receives property valued at over $100,000.

Dr. Louis C. Karpinski has been promoted from associate professor to professor of mathematics at the University of Michigan.

Dr. Eugene Taylor, formerly instructor who has been taking graduate studies at Harvard University, and Dr. E. P. Lane, of the Rice Institute, have been appointed assistant professors of mathematics at the University of Wisconsin.

Dr A. K. Lobeck, instructor at Columbia University from 1916–18 and during the past year assistant to the chief cartographer, American Commission to Negotiate Peace, Paris, has been appointed assistant professor of geology at the University of Wisconsin.

Dr. John T. Buchholz, of the West Texas State Normal College, has been appointed professor of botany in the University of Arkansas.

Dr. J. Graham has been appointed professor of anatomy in the Anderson College of Medicine, Glasgow, in succession to the late Dr. A. M. Buchanan.

DISCUSSION AND CORRESPONDENCE

ATMOSPHERIC POLLUTION[1]

THE Advisory Committee on Atmospheric Pollution has published its fourth report summing up the observations in the year 1917–1918.

The full lists showing in detail the monthly deposit figures at various stations are not reproduced, inasmuch as these have been already published in the *Lancet;* but full returns from two stations, Newcastle and Malvern, are given; and these give the highest and lowest deposits.

Figures of total solids deposited monthly are given for all stations, 24 in number, the months being on a thirty-day basis.

In many instances the rainfall as measured at these stations did not agree with the amount obtained by the official Meteorological Office gauges but this is easily explained when it is remembered that the gauges of the committee are often on roofs and are thus elevated. The rainfall is given in millimeters, and it would be well if we in the United States would follow this example.

At a given London station the data for the half year, October to March, 1917–1918, were:

Rainfall 43 mm.; tar 0.14 metric ton per square kilometer; carbonaceous matter other than tar 2.18 tons; insoluble ash 3.50; soluble ash 4.15; or total solids 11.41 tons. Of the soluble matter there were 1.46 tons of sulphate, 0.63 tons of chlorine, and 0.05 of ammonia.

No relationship can be discovered between the deposit of insoluble matter and the amount of rainfall. With the soluble matter, however, it is different, and in general it may be said to vary directly as the rainfall. The relation may be roughly expressed by the formula, $S = 0.058\ R + 2.5$, where R is the rainfall in mm. and S the deposit of soluble matter in tons per square kilometer. It is not suggested that this expression can be used to find the soluble deposit when the rainfall is known but gives only the general nature of the relationship.

[1] Meteorological Office. Report on Observations 1917–18. Advisory Committee on Atmospheric Pollution, London, 1919.

The report also contains the results of analysis of the rainfall at Georgetown, British Guiana, the nearest land in the direction of the prevailing east-northeast trade winds being the shore of Morocco, distant 3,000 nautical miles. There can be little doubt that the solids contained in the rain waters collected are those normal to the rains of the trade winds, with perhaps some derived from the coastal sea-spray.

The average results over the two years 1916 and 1917 were as follows:

	Solids in Solution, mg./litre
Ca	7.95
Mg	3.44
K	2.77
Na	16.36
Al_2O_3	0.58
Fe_2O_3	1.97
SiO_2	0.20
Cl_2	33.93
SO_4	12.02
CO_3	9.78
NO_3	11.57
NH_4	0.12
	100.69

It is shown that 55 per cent. of the solids in solution in the rainfall are cyclic sea salts, while 45 per cent. must have been derived from atmospheric sources.

The report also contains an account of certain experiments made to determine the best method of measuring continuously the suspended impurity in the air. A. M.

CAROTINOIDS AS FAT-SOLUBLE VITAMINE

MY attention has been called to Steenbock's interesting observation, in SCIENCE of October 10, that yellow corn and the colored roots, such as carrots and sweet potatoes, are richer in fat-soluble vitamine than white corn and the pigmentless roots and tubers. A number of other instances are noted in which fat-soluble vitamine and carotinoid pigment occur simultaneously. The fact that these relations have led Steenbock to the provisional assumption that the fat-soluble vitamine is one of the carotinoid pigments has prompted me to call attention to a number of cases where this relation apparently breaks down.

Drummond[1] has recently tested the possibility of carotin being the fat-soluble vitamine by feeding both crude and crystalline preparations of the pigment to rats, although the question may be raised as to the logic of testing the relation to fat-soluble vitamine of a substance of which is not natural to the body of the animal upon which the test is performed. Carotin is not found in the body of the rat.

The writer[2] has recently reported the fact that it is possible to raise a flock of chickens from hatching to maturity on a diet free, or at most containing the merest traces, of carotinoids. Not only did the mature hens lay eggs whose yolks were free from carotinoids, but a second generation of carotinoid-free chicks were hatched from them. Only one of two possible conclusions can be drawn from this experiment. Either the fat-soluble vitamine and the yellow plant pigments are not related physiologically or the fat-soluble vitamine requirement of fowls differs from that of mammals. The diet which we used for the successful growth of the chickens contained an abundance of fat-soluble vitamine, however, in the form of carotinoid-free pork liver.

Another interesting case of negative relation between carotinoids and fat-soluble vitamine is seen in the fact that a number of species of animals, such as sheep, swine, dogs, cats, rats, rabbits, and guinea pigs are free from carotinoids in blood[3] and adipose tissues, and nerve cells.[4] The milk fat of the mammals of these species is also colorless. How is one to make the successful raising of young on carotinoid-free milk coincide with the assumption that fat-soluble vitamine is one of the yellow plant pigments?

Still another instance of negative relation between carotinoids and fat-soluble vitamine is seen in the case of certain vegetable oils, like cottonseed oil. Fresh cottonseed oil, after being purified from resinous material, has a beautiful golden yellow color and is rich[5] in carotinoids. It should also contain an abundance of fat-soluble vitamine to be in keeping with Steenbock's assumption. Apparently this is not the case since both bleached and unbleached cottonseed oil has been found to be free from vitamine.[6] The oil from yellow corn, similarly, should contain the vitamine, but the same investigation[6] has reported failure to obtain growth with diets containing the commercial unbleached corn oil.

It is thus possible to cite a number of instances where the probable relation between carotinoids and fat-soluble vitamine breaks down. No doubt others could be found. The writer regards the instances of a simultaneous occurrence of fat-soluble vitamine and plant carotinoids as fortuitous. The similarity of certain of the properties of the two kinds of material admittedly offers a working basis for the ultimate isolation of the fat-soluble vitamine, and research in this direction offers many fascinating possibilities. The relation between the vitamine and color in the case of corn may be a genetic one, in which case it should be possible to transfer the vitamine to white corn. Further attempts, however, to establish an identity of the vitamine with one of the carotinoid pigments is not likely to lead to profitable results.

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1 J. C. Drummond, *Biochem. Jour.*, XIII., 81, 1919.

2 L. S. Palmer and H. L. Kempster, *Jour. Biol. Chem.*, XXXIX., 299, 1919.

3 L. S. Palmer, *Jour. Biol. Chem.*, XXVII., 27, 1916.

4 D. H. Dolley and Frances Guthrie, Science, N. S., L., 190, 1919.

5 L. S. Palmer and C. H. Eckles, Missouri Agr. Exp. Sta. Res. Bull. 10, 361, 1914.

6 E. V. McCollum, N. Simmonds and W. Petz, *Am. Jour. Physiol.*, 41, 361, 1916.

SCIENTIFIC ARTICLES

WOUND HEALING IN EXPERIMENTAL (CELLFIBRIN) TISSUE[1]

1. If we make a defect in the skin, processes of healing set in which in time lead to a closure of the wound. Primarily, the defect

1 From the Department of Comparative Pathology, Washington University School of Medicine, St. Louis and the Marine Biological Laboratory, Woods Hole, Mass.

calls forth an emigration of epidermal cells into the wound. Secondarily, cell proliferation by mitosis and a contraction of fibrous tissue takes place and these three processes contribute to the wound closure. Under certain conditions the intensity of cell migration depends upon the size of the wound; and the contraction of the wound, depending in all probability on the contraction of the fibrous tissue and the number of retracting fibers being greater in the larger than in the smaller wound, shows a certain quantitative relation to the size of the wound.

Essentially and disregarding complicating factors, the same stimulus leads to the migration of cells and to cell prolification in wound healing.[2] To understand wound healing it is necessary to study experimentally the conditions which influence the migration of the cells into the wound. The important fact in wound healing is that in a tissue which was previously at rest, the making of a defect calls forth new activities in the cells adjoining the wound.

2. In earlier investigations we have shown that after the shedding of the blood of *Limulus* the amœbocytes agglutinate and thus produce a tissue-like organization which under certain experimental conditions bears a certain resemblance to epithelial, under others to connective tissue. This agglutination of cells is not accompanied by a transformation of fibrinogen into fibrin.[3] Subsequently we observed that an emigration of cells takes place from such tissue if pieces of this "cellfibrin" are put on a slide and kept under suitable conditions.[4]

We have recently resumed these experiments and have succeeded in working out methods which permit us within certain limits to imitate in an experimental tissue composed of agglutinated blood cells processes which are characteristic of normal tissues.

[2] A more detailed discussion of these conditions will be given in a forthcoming paper on wound healing in the *Journal of Medical Research*.

[3] Leo Loeb, *Biological Bulletin*, 1903, IV., 301; *Virchow's Archiv*, 1903, Vol. 173, 35.

[4] Leo Loeb, *Biochem. Zeitschrift*, 1909, XVI., 157.

3. In such experimental "cellfibrin" tissue the processes of wound healing and tissue grafting can be imitated, as far as the primary process in wound healing, namely the formation of layers of regenerating tissue through migration, is concerned. A defect in this artificial tissue, measuring about 6–8 square mm. can be closed in the course of two to three days, and a piece of tissue grafted into a defect can be seen to unite with the host tissue through regeneration taking place in the host as well as in the graft. We have every reason to believe that the essential factors underlying these healing processes in the skin of a mammal and in such experimental cellfibrin tissue are very similar. In both cases a tissue which has been in a resting condition is made to migrate into a wound under the influence of the wound stimulus.

4. In order to produce cellfibrin tissue, we collect in a stender dish a certain quantity of blood of a large *Limulus* under conditions which preserve the blood cells as much as possible. The latter form several layers on the bottom of the dish. The cells are glued to each other as well as to the bottom of the dish and thus form a compact even layer of tissue. With a scalpel we can make wounds of various sizes in this tissue and then readily follow with a low power of the microscope the different stages of wound healing. At the border of the wound we may recognize the outgrowth of the regenerated tissue even with the naked eye. In this defect we can transplant tissue of the same kind and follow the union between host and graft.

We may furthermore cut out a very small piece of tissue, place it on a cover glass, add a drop of blood serum or other fluid, and fix it with vaselin on a hollow slide, in the same way as in the case of other tissues growing in vitro. We can thus follow the radial outgrowth of the tissue. The pictures obtained correspond closely to those seen in the vitro culture of other tissues.

5. We have begun an analysis of the conditions determining wound healing in this

experimental cellfibrin tissue; we shall mention here a few of the results obtained so far.

(*a*) The influence of the temperature is very marked. The temperature coefficient seems to be such as might be expected, if wound healing depended upon chemical processes. While regeneration takes place steadily even in the ice chest at a temperature of from 6–10°, the outgrowth is much more rapid at a temperature of about 20°. Here however also secondary changes take place much more rapidly in the outgrowing cells.

(*b*) The depth of the layer of blood serum covering the wound or piece of cellfibrin does not seem to influence the rapidity of the healing process. This seems to indicate that the quantity of oxygen supplied is sufficient, even if a layer of serum about 10 mm. deep separates the tissue from the oxygen of the atmosphere. The amount of free oxygen was still further diminished in experiments made by Miss Clinton. Hydrogen passed through the blood serum for one hour previous to the introduction of the tissue into the serum. This was followed by a second period lasting fifteen minutes in which again hydrogen was carried through the serum. Even under these conditions outgrowth took place from pieces of cellfibrin previously placed on cover glasses.

(*c*) In a third set of experiments we compared the intensity of tissue movements in tissue growing in or against the direction of gravity. The tissue was held in a vertical position on the cover glass. We found that the tissues can grow out against the direction of gravity as well or almost as well as in the opposite direction. The average intensity of outgrowth is probably somewhat greater in the direction of gravity than in the opposite direction.

(*d*) If we observe tissue growing towards each other from different parts of a wound, or from two separate pieces of cellfibrin placed near each other, we find that the cells coming from opposite directions intermingle quite freely with each other. There is apparently no repellent action exerted by one sheet of tissue upon the movements of the others. It is evidently not the products of metabolism of certain cells which induce the cells to become active and to leave the position in which they had been at rest.

(*e*) By using our method it is possible to alter experimentally the base on which the tissue moves. Thus we can substitute a surface of paraffin, vaselin, coagulated egg or agar for glass or cellfibrin tissue. It is of considerable theoretical interest to determine the character of ameloid movements on substances like paraffin. We find that even on paraffin and vaselin an excellent outgrowth of tissue can take place, although the physical properties of these substances modify in some respects the behavior of the tissue cells. On coagulated egg and agar outgrowth takes place likewise but secondarily osmotic or chemical factors may come into play and injure the cells.

(*f*) We have begun the study of the effect of various inorganic substances, particularly of constituents of the blood and seawater on the movement of cellfibrin tissue in wound healing, and on ameboid movement in general. According to their effect on the tissue movements, we can arrange the various substances in the following order: (1) 2/3–1/2 *m* NaCl, (2) 2/3–1/2 *m* KCl, (3) 1/2 *m* $CaCl_2$, (4) *m*/3 Na_2 HPO4, (5) 5/8 *m* N H_4Cl, (6) *m*/3 Na H_2 P O4, (7) H_2O. NaCl is the least and N H_4Cl, Na H_2 P O.4 and H_2O are most injurious. In the latter solutions no distinct outgrowth takes place. How far certain variable factors as the amount of blood serum adherent to the tissue or bacterial infection may modify the results will have to be determined in further experiments.

Dilution of the solution within certain limits is not incompatible with outgrowth. Thus outgrowth can be readily obtained in a solution of 5 c.c. 5/8 *m* NaCl + 3 c.c. H_2O; addition of as much as 0.5 c.c. of a *m*/100 HCl or NaOH solution to 5 c.c. 5/8 *m* NaCl likewise permits frequently the outgrowth of tissue.

We wish to express our thanks to Mr. Julian P. Scott, who assisted us in these experiments.

Leo Loeb

THE AMERICAN CHEMICAL SOCIETY. IV

Symposium on annual patent renewal fees with the Division of Pharmaceutical Chemistry and Section of Dye Industry. E. J. PRINDLE, *chairman.* The symposium discussed various features of the proposal that a system of annual patent renewal fees shall be adopted for the United States. There were verbal or written discussions by: T. H. Anderson, L. H. Baekeland, J. M. Francis, Edwin A. Hill, A. D. Little, John Uri Lloyd, L. V. Redman, Mr. Stinchfield, Elihu Thomson, W. R. Whitney and others, including members of the Patent and Related Legislation Committee of the American Chemical Society, and members of the Patent Committee of the National Research Council. The chief ideas brought out in this discussion were found in the October, 1919, issue of the *Jour. Ind. and Eng. Chemistry.*

The use of crystallizers in cane sugar manufacture: CHARLES E. COATES.

The centrifugal method for the rapid determination of potash: L. S. CONVERSE. For control work, the common methods too long. Description of centrifugal method. Calibration of tubes, effect of speed and time on centrifuge effect of other salts, etc. Comparison of centrifuge and other methods. Usefulness and accuracy of method. It is impossible to obtain results accurate to 0.1 per cent. if the sample contains more than 12 per cent. potassium nitrate. Because of rapidity—20 minutes—it is useful for control work.

Comparison of methods for determining ammonium nitrate: J. T. GRISSOM. Need of rapid method for estimating ammonium nitrate. Comparison of nitrometer, kjeldahl and formaldehyde methods.

Effects of chlorides on nitrometer determinations of nitrates: M. T. SANDERS. It is not possible to determine nitrates in the presence of larger amounts of chlorides. Determinations with known quantities of chloride are given, results are discussed and reasons for abnormal results suggested. It is impossible to obtain results accurate to 0.1 per cent. if more than 15 to 17 per cent. sodium chloride is present in the dried sample.

The oxidation of methane. Quartz combustion apparatus: F. C. VILBRANDT and JAMES R. WITHROW.

Carbon black—its properties and uses: G. ST. J. PERROTT. An investigation of the carbon black industry has been undertaken by the United States Bureau of Mines as a result of economic issues brought up during the war. In the present process of manufacture carbon black is made by burning natural gas with a smoky flame against a metal surface and collecting the liberated carbon. The yield is from 2 per cent. to 7 per cent. of the total carbon in the gas. Other possible methods of making carbon black are considered. The uses of carbon black are discussed with particular attention to the ink and rubber industries. Testing methods are described and results of chemical and microscopic analyses of blacks making "long" and "short" inks are given. An explanation for the difference in working qualities of blacks made by different processes is proposed.

Adherent rust as an accelerator in the corrosion of iron and steel: W. D. RICHARDSON.

Some properties of commercial silicate of soda: J. G. VAIL.

The leaching of zinc chloride from treated wood: ERNEST BATEMAN. As the result of experimental work and analyses of ties which have seen several years' service, the following conclusions have been drawn: (1) In laboratory experiments as well as service tests the chlorine radical was drawn from the wood by leaching faster than the zinc radical. (2) The amount of each component leached can be calculated with fair accuracy from the diffusion constants of the hydrochloric acid and zinc chloride and the amount of each component present in the solution. (3) From the above it follows that the relative rate of leaching of any other salt from wood can be calculated if we know the amount injected and the diffusion constants of the salt. (4) The presence of comparatively large amounts of zinc in treated material does not insure that the wood is protected against decay unless a sufficient amount of acid be also shown to be present. (5) The basic chlorides of zinc seem to have little or no toxic effect.

Tensile strength of glue: G. HOPP. The paper describes a method for testing glue, by determining its exact tensile strength and elasticity. Hitherto all methods used were more or less arbitrary and entirely comparative. It was shown conclusively that the method is exact and opens a wide field for research and scientific standardization not only of methods of testing glue but also of selecting the right glue for a particular purpose.

A new illuminator for microscopes: A. SILVERMAN.

The stability of tetryl: C. L. Knowles. The following is an outline of the paper: Historical, general methods of preparation; general methods of purification; properties; most common impurities; causes of instability in tetryl; methods of testing stability of tetryl; action of sodium carbonate on tetryl; detection of sodium picrate in tetryl; effect of sodium picrate on stability of tetryl; conclusions; references.

The manufacture of trinitroxylene: John Marshall. The paper included the following: Discussion of preliminary experiments on the production of TNX; a study of the properties of a mixture of TNX and TNT when cast together; a discussion of the fraction of xylene best adapted to the production of TNX for explosive shell filling. The methd of nitrating; the nitration of pure meta-xylene; the composition of the mixed acid; the study of raw materials with particular reference to the rectification of solvent naphtha and the results obtained from the various ranges of the xylene fraction; the relative suitability of coke oven and water gas tar xylenes.

The preparation of hexanitro-diphenylamine and its use as a booster for shell charges: John Marshall. The following is an outline of the paper: Historical; the preparation of dinitrodiphenylamine; preparation of tetranitrodiphenylamine; nitration of tetranitrodiphenylamine to hexanitrodiphenylamine; preparation of hexanitrodiphenylamine by complete nitration of dinitrophenylamine with mixed acid; the neutralization of free acid in hexanitrodiphenylamine; the explosive properties of hexanitrodiphenylamine; sensitiveness of hexanitrodiphenylamine to detonation; sensitiveness to impact; sensitiveness to friction; rifle bullet test; explosive power of hexanitrodiphenylamine; effect as a booster; conclusions.

The composition of sponges: F. P. Dunnington. The common sponge, used in washing, grows in some warmer ocean waters and consists of a network of fiber-like material which is somewhat related in composition to silk fiber. Sponge has long been known to contain the somewhat rare element iodine, and occasionally bromine is mentioned as occurring with it; but little has been published about it that is definite. The author proposed to determine the exact amounts of iodine, bromine and chlorine in some sponges from different sources, and specimens from Florida, Cuba and Bahama Islands were analyzed. The amounts of these elements in these specimens differ greatly, but the average percentages for the four specimens examined are, viz.: iodine, .603; bromine, 1.307; chlorine, 1.06. When we consider the very small amount of bromine and the minute trace of iodine found in the water of the ocean, it is indeed remarkable that these animal organisms can thus select and collect them from the large portion of chlorine in the salt found there. We also note in this an explanation of the fact that these sponges can only grow in "open ocean water."

Quantitative determination of potassium as bitartrate: Sigmund Waldbott and Fred. W. Weissmann. This method was evolved in order to avoid the use of the expensive and difficultly accessible platinum chloride. It is applicable to mixtures of K- and Na-salts resulting from the regular analytical separation of other metals including Ca and Mg. Principle of procedure: To the *neutral* solution of K- and Na-salts add Na-bitartrate in slight excess, evaporate to dryness, displace the water-soluble salts by means of water saturated with cream of tartar at or slightly below the temperature of the laboratory, then judiciously displace the cream of tartar solution by the careful addition of alcohol. A straight calcium chloride tube containing a plug of cotton is useful in these operations. Finally heat to 100° C. for 1 hour in a current of air, cool and weigh. Fair uniformity of temperature is essential for the accuracy of the method.

The properties of pyroxylin plastics: R. P. Calvert and J. H. Clewell.

The extraction of potash salts from kelp charcoal: J. W. Turrentine, P. S. Shoaff and G. S. Spencer. The charcoal yielded by the destructive distillation of dried kelp is porous and readily yields its values, potassium and sodium chlorides and iodides when treated with hot water. In order to obtain a highly concentrated solution and at the same time efficient extraction, some counter-current system was found to be necessary. A solution of the problem was found in the adoption of a number of mechanical filter presses connected in series with each other and with leaching troughs interposed. The brine from one press is pumped into the leaching trough of the preceding one, while the press-cake from each press falls into the leaching trough of the succeeding one. Thus the brine is pumped up hill while the charcoal passes downward by gravity. The two streams passing in opposite directions counter-current extraction results. Filter presses of the revolving disk type and known as the American are employed. Filtration and washing are effected under vacuum and the press cake is broken loose by compressed air. The apparatus

shows high efficiency, is automatic and is regarded as eminently satisfactory.

"Kelpchar" a new decolorizing carbon prepared as a by-product in the extraction of potash from kelp: J. W. TURRENTINE, P. S. SHOAFF and G. C. SPENCER. Following the researches in the laboratories, respectively, of Dr. F. W. Zerban, of the Louisiana Sugar Experimental Station and of the Experimental Kelp Plant, of the United States Department of Agriculture, it was shown that a carbon of high activity could be produced in large quantities from kelp, depending on the method of retorting. One-stage retorting was efficacious, under certain conditons but did not yield a product of uniform or even dependable grade. Two-stage retorting, however, did yield a product of constant properties and made possible the large scale production. Accordingly this method was instituted pending the determination of the optimum conditions surrounding the one-stage operation. The product of the retorting or destructive distillation of kelp, a porous charcoal, is leached with hot water to remove potassium chloride and iodide and the residue, in the form of a press cake, is treated with the required amount of hot, dilute HCl to dissolve out soluble constituents and is then washed with water to neutrality. It is then dried and sacked for shipment. The tank system of extraction at present is in use. Acid proof construction is employed. The material is transferred from tank to tank in the sludge form by means of pumps, and spent acid and water are removed by filtering in situ over vacuum. The product compares favorably with Norit on molasses solution being equal in value and shows great usefulness when applied to materials of widely varying characteristics. It offers every promise ultimately of meeting the requirements of the chemical industry for a carbon of the highest grade.

CHARLES L. PARSONS,
Secretary

(*To be continued*)

THE AMERICAN ASTRONOMICAL SOCIETY

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THE twenty-third meeting of the society was held September 2 to 5, 1919, at the University of Michigan, Ann Arbor, where during the same week were also being held meetings of the American Mathematical Society and of the Mathematical Association of America. Members of all three societies were housed at the Newberry Residence and at the Michigan Union, and the arrangements demonstrated the ideal condition of gatherings where members live close together for several days. There were about seventy members and guests present at the astronomical sessions.

In opening the first session, Acting President Schlesinger referred to the great loss which the society had suffered since the last meeting in the death of Professor Edward C. Pickering, who had been president of the society for thirteen years, and who had been the leading figure at its meetings throughout that time. The society had also lost Professor Charles L. Doolittle, who had acted as treasurer from the founding of the society in 1899 until he retired in 1912. The following resolution, which had been passed by the Council, was endorsed as representing the sentiment of the members of the society, and was ordered to be printed in the publications.

The council of the American Astronomical Society records with regret the death on February 3, 1919, of EDWARD CHARLES PICKERING, who had been president of the society since December 30, 1905. His success in introducing new methods into the observatory, particularly with regard to the determination of the brightness and the spectra of stars, his extraordinary ability in carrying out large projects, and the extent and diversity of his experience and knowledge, have given him a permanent place among the great names in the history of science. The society will keenly feel the loss of his presence at its meetings. The members of the society had every reason to regard him as a warm friend, and to them the sense of personal loss is very deep.

The visitors at Ann Arbor were hospitably entertained by the University of Michigan, and especially by Director and Mrs. Hussey at the Observatory. There was also opportunity to join forces with the mathematicians at a smoker and a dinner. There was one joint meeting of the three societies, with the following program.

"Mathematics and statistics." Retiring address of the president of the Mathematical Association of America. Professor E. V. Huntington, Harvard University.

"The work of the National Research Council with reference to mathematics and astronomy." Professor Ernest W. Brown, Yale University.

"Reports on the International Conference of Scientists at Brussels." Dr. Frank Schlesinger, Allegheny Observatory, Dr. L. A. Bauer, Carnegie Institution.

The time and place of the next meeting of the Astronomical Society was left to be determined by the executive committee.

Officers were elected for the ensuing year:

President—Frank Schlesinger.

Vice-presidents—George C. Comstock, Walter S. Adams.

Secretary—Joel Stebbins.

Treasurer—Benjamin Boss.

Councilors—Ernest W. Brown, Otto Klotz, Solon I. Bailey, W. J. Hussey, Henry Norris Russell, V. M. Slipher.

The program of papers was as follows:

Variations of type in the Cepheid variables l Carinae and η Aquilæ as shown by the general spectrum: Sebastian Albrecht.

A systematic search for novæ at the Harvard Observatory: S. I. Bailey.

On the change in the period of the variable star Bailey No. 33 in the cluster M5: E. E. Barnard.

Remeasurement of Hall's star in the Pleiades: E. E. Barnard.

Variable stars in M 11: E. E. Barnard.

On the varnishing of astronomical negatives: E. E. Barnard.

Some observations of the total solar eclipse on May 29, 1919, at Cape Palmas, Liberia: L. A. Bauer.

Hypersensitizing commercial panchromatic plates: S. M. Burka. (Introduced by C. C. Kiess.)

Some recent developments in the study of SS Cygni: Leon Campbell.

The spectra of variable stars of long period: Annie J. Cannon.

Atmospheric refraction near the horizon: George C. Comstock.

Studies of class B spectra having hydrogen emission: R. H. Curtiss.

Fluctuations in the moon's longitude in relation to meteorological variations: Ralph E. DeLury.

Apparent relation between Chinese earthquakes and California tree growths, 0–1680 A.D.: Ralph E. DeLury.

Levels of the Great Lakes in relation to numbers of sun-spots: Ralph E. DeLury.

Simultaneous spectroscopic observations of the rate of rotation in north and south solar hemispheres: Ralph E. DeLury.

The periodograph and its application to variable star periods and other problems: A. E. Douglass.

On the eclipsing variables RT Persei and U Cephei: R. S. Dugan.

Preliminary results of a comparative test of the 100-inch and 60-inch telescopes of the Mount Wilson Observatory: George E. Hale.

Rates of the standard sidereal clocks at the U. S. Naval Observatory: J. C. Hammond and C. B. Watts.

Note on the spectrum of Nova Aquilæ No. 3: W. E. Harper.

The orbit of the spectroscopic binary ι Delphini: W. E. Harper.

The orbit of the spectroscopic binary Boss 4507: W. E. Harper.

A desideratum in solving Kepler's problem: H. A. Howe.

The red and infra-red arc spectra of eight elements: C. C. Kiess and W. F. Meggers.

Color-index of planets: Edward S. King.

Photographic observations of the Great Nebula in Orion: C. O. Lampland.

Star tables good to the year 2000 for civil engineers and navigators: H. C. Lord.

Origin of the sun's heat: W. D. MacMillan.

False spectra produced by gratings: W. F. Meggers, C. C. Kiess and F. M. Walters, Jr.

Evidences of change in coronal structure during the eclipse of June 8, 1918: J. A. Miller.

The masses of 32 visual binary stars: J. A. Miller and J. H. Pitman.

Measures of double stars on photographs: Charles P. Olivier.

Shifting absorption at the heads of the brighter helium bands in the spectrum of γ Argus: C. D. Perrine.

Methods of asteroid observation and reduction: George Henry Peters.

The great eruptive prominences of May 29 and July 15, 1919: Edison Pettit.

Studies in prominence characteristics: Edison Pettit.

The proper motions and parallaxes of 359 stars in the cluster h Persei: Hannah Steele Pettit.

The spectroscopic orbits and dimensions of the eclipsing variables U Ophiuchi, RS Vulpeculæ, and TW Draconis: J. S. Plaskett.

Report on progress of work with the 72-inch telescope: J. S. Plaskett.

Annular eclipse of the sun of 1919, November 22, as visible in the United States: Wm. F. Rigge.

Direct micrometrical observations of the sun: E. D. Roe, Jr.

The spectrum of the milky way: V. M. Slipher.

All-American time: Elliott Smith.

Progress in photo-electric photometry: Joel Stebbins.

Peirce's criterion: R. M. Stewart.

The treatment of discordant observations: R. M. Stewart.

Tests of dyes for red and infra-red photography: Florence J. Stocker.

Experiments with Kapteyn's method for reducing guiding error: R. Trümpler and Frank Schlesinger.

Meridian circle observations of Nova Aquilæ No. 3: R. H. Tucker.

The use of semi-absolute photographic positions in double star astronomy: George Van Biesbroeck.

Note on proper motions of certain long period variable stars: Anne S. Young and Louise F. Jenkins.

Three spectroscopic binary orbits: Reynold K. Young.

Joel Stebbins,
Secretary

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